

FORM PTO-1390
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U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK

ATTORNEY'S DOCKET NUMBER

449122002600

**TRANSMITTAL LETTER TO THE UNITED STATES
DESIGNATED/ELECTED OFFICE (DO/EO/US)
CONCERNING A FILING UNDER 35 U.S.C. § 371**

U.S. APPLICATION NO. (If known, see 37 CFR 1.5)

09/806776

PRIORITY DATE CLAIMED

INTERNATIONAL APPLICATION NO.

PCT/DE99/03179

INTERNATIONAL FILING DATE

October 1, 1999

October 5, 1998

TITLE OF INVENTION

METHOD FOR SETTING UP A COMMUNICATION LINK IN A TELECOMMUNICATION NETWORK

APPLICANT(S) FOR DO/EO/US

Heinrich HUMMEL

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☐ This is an express request to begin national examination procedures (35 U.S.C. 371(f)). The submission must include items (5), (6), (9) and (21) indicated below.
4. ☒ The US has been elected by the expiration of 19 months from the priority date (PCT Article 31).
5. ☒ A copy of the International Application as filed (35 U.S.C. 371(c)(2))
 - a. ☒ is attached hereto (required only if not communicated by the International Bureau).
 - b. ☒ has been communicated by the International Bureau.
 - c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☒ An English language translation of the International Application under PCT Article 19 (35 U.S.C. 371(c)(2)).
 - a. ☒ is attached hereto.
 - b. ☐ has been previously submitted under 35 U.S.C. 154(d)(4).
7. ☐ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3)).
 - a. ☐ are attached hereto (required only if not communicated by the International Bureau).
 - b. ☐ have been communicated by the International Bureau.
 - c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
 - d. ☐ have not been made and will not be made.
8. ☐ An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☐ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. ☒ An English language translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

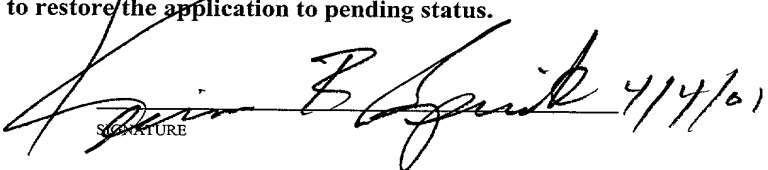
Items 11. to 16. below concern document(s) or information included:

11. ☒ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. ☒ A **FIRST** preliminary amendment.
14. ☐ A **SECOND** or **SUBSEQUENT** preliminary amendment.
15. ☐ A substitute specification.
16. ☐ A change of power of attorney and/or address letter.
17. ☐ A computer-readable form of the sequence listing in accordance with PCT Rule 13ter.2 and 35 U.S.C. 1.821 - 1.825.
18. ☐ A second copy of the published international application under 35 U.S.C. 154(d)(4).
19. ☐ A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4).
20. ☒ Other items or information: 1. IPER 2. International Search Report 3. Application Data Sheet 4. Return receipt postcard.

CERTIFICATE OF HAND DELIVERY

I hereby certify that this correspondence is being hand filed with the United States Patent and Trademark Office in Washington, D.C. on April 4, 2001.

Bridget Christian

U.S. APPLICATION NO. (if known, see 37 CFR 1.5) * 097806776		INTERNATIONAL APPLICATION NO PCT/DE99/03179		ATTORNEY'S DOCKET NUMBER 449122002600	
21. <input checked="" type="checkbox"/> The following fees are submitted: BASIC NATIONAL FEE (37 CFR 1.492(a)(1)-(5)): Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO.....\$1,000.00 International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO.....\$860.00 International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO.....\$710.00 International preliminary examination fee (37 CFR 1.482) paid to USPTO but all claims did not satisfy provision of PCT Article 33(1)-(4)\$690.00 International preliminary examination fee (37 CFR 1.482) paid to USPTO and all claims satisfied provisions of PCT Article 33(1)-(4)\$100.00				CALCULATIONS PTO USE ONLY	
ENTER APPROPRIATE BASIC FEE AMOUNT =				\$860.00	
Surcharge of \$130.00 for furnishing the oath or declaration later than <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492(e)).				\$	
CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE	\$	
Total claims	11 - 20 =	0	x \$18.00	\$0	
Independent claims	1 - 3 =	0	x \$80.00	\$0	
MULTIPLE DEPENDENT CLAIM(S) (if applicable)			+ \$270.00	\$*	
TOTAL OF ABOVE CALCULATIONS =				\$860.00	
<input type="checkbox"/> Applicant claims small entity status. See 37 CFR 1.27. The fees indicated above are reduced by 1/2.				\$*	
SUBTOTAL =				\$860.00	
Processing fee of \$130.00 for furnishing the English translation later than <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492(f)).				+	\$0
TOTAL NATIONAL FEE =				\$860.00	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). \$40.00 per property				+	\$0
TOTAL FEES ENCLOSED =				\$860.00	
				Amount to be refunded:	\$*
				charged:	\$860.00
a. <input checked="" type="checkbox"/> A check in the amount of \$860.00 to cover the above fees is enclosed. b. <input type="checkbox"/> The Commissioner is hereby authorized to charge any additional fees that may be required, or credit any overpayment to <u>Deposit Account No. 03-1952</u> . A duplicate copy of this sheet is enclosed.					
NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.					
SEND ALL CORRESPONDENCE TO: Kevin R. Spivak Morrison & Foerster LLP 2000 Pennsylvania Avenue, N.W. Washington, D.C. 20006-1888					
 SIGNATURE Kevin R. Spivak Registration No. 43,148					

Please type a plus sign (+) inside this box → ☐

09/806776

PTO/SB/05 (11-00)

Approved for use through 10/31/02. OMB 0651-0032

U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

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**UTILITY
PATENT APPLICATION
TRANSMITTAL**

Attorney Docket No. 449122002600

First Inventor Heinrich HUMMEL

Title

METHOD FOR SETTING UP A COMMUNICATION LINK IN A
TELECOMMUNICATION NETWORK

(Only for new nonprovisional applications under 37 CFR 1.53(b))

CERTIFICATE OF HAND DELIVERY

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Bridget Christian
Bridget Christian

APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents.

ADDRESS TO:

Assistant Commissioner for Patents
Box Patent Application
Washington, DC 20231

1. ☒ Fee Transmittal Form (e.g. PTO/SB/17)
(Submit an original, and a duplicate for fee processing)
2. ☐ Applicant claims small entity status.
See 37 CFR 1.27
3. ☒ Specification [Total Pages 17]
(preferred arrangement set forth below)
- Descriptive title of the Invention
- Cross Reference to Related Applications
- Statement Regarding Fed sponsored R & D
- Reference to sequence listing, a table, or a
computer program listing appendix
- Background of the Invention
- Brief Summary of the Invention
- Brief Description of the Drawings (if filed)
- Detailed Description
- Claim(s)
- Abstract of the Disclosure
4. ☒ Drawing(s) (35 USC 113) [Total Sheets 3]
5. Oath or Declaration [Total Pages *]
a. ☐ Newly executed (original or copy)
b. ☐ Copy from a prior application (37 CFR 1.63(d))
(for continuation/divisional with Box 17 completed)
i. ☐ **DELETION OF INVENTOR(S)**
Signed statement attached deleting inventor(s) named in the
prior application, see 37 CFR 1.63(d)(2) and 1.33(b)
6. ☒ Application Data Sheet. See 37 CFR 1.76

7. ☐ CD-ROM or CD-R in duplicate, large table or Computer
Program (Appendix)
8. Nucleotide and/or Amino Acid Sequence Submission
(if applicable, all necessary)
a. ☐ Computer Readable Form (CRF)
b. Specification Sequence Listing on.
i. ☐ CD-ROM or CD-R (2 copies); or
ii. ☐ paper
c. ☐ Statements verifying identify of above copies

ACCOMPANYING APPLICATION PARTS

9. ☐ Assignment Papers (cover sheet & document(s))
10. ☐ 37 CFR 3.73(b) Statement [] Power of Attorney
(where there is an assignee)
11. ☒ English Translation document (if applicable)
12. ☒ Information Disclosure Statement [] Copies of IDS
(IDS)/PTO-1449 Citations
13. ☒ Preliminary Amendment
14. ☒ Return Receipt Postcard (MPEP 503)
Should be specifically itemized
15. ☐ Certified Copy of Priority Document(s)
(if foreign priority is claimed)
16. ☐ Request and Certification under 35 U.S.C. 122(b)(2)(B)(i) Applicant
must attach form PTO/SB/35 or its equivalent.
17. ☐ Other

18. If a CONTINUING APPLICATION, check appropriate box and supply the requisite information below and in a preliminary amendment, or in an Application Data Sheet under 37 CFR 1.76:

☐ Continuation ☐ Divisional ☐ Continuation-in-part (CIP) of prior application No. *

Prior application information.

Examiner *

Group / Art Unit *

For CONTINUATION OR DIVISIONAL APPS only: The entire disclosure of the prior application, from which an oath or declaration is supplied under Box 5b, is considered a part of the disclosure of the accompanying continuation or divisional application and is hereby incorporated by reference. This incorporation can only be relied upon when a portion has been inadvertently omitted from the submitted application parts.

19. CORRESPONDENCE ADDRESS

☐ Customer Number or Bar Code Label

or ☐ Correspondence address below



25227

PATENT TRADEMARK OFFICE

(Insert Customer No. or Attach bar code label here)

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Signature	<i>Kevin R. Spivak</i>			Date	April 4, 2001	

09/806776

PATENT

Docket No. 449122002600

Client Reference 1998P02876WOUS

CERTIFICATE OF HAND DELIVERY

JC08 Rec'd PCT/PTO

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Bridget Christian

Bridget Christian

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In the application of:

Heinrich HUMMEL et al.

Serial No.: Not yet Assigned

Filing Date: April 4, 2001

For: METHOD FOR SETTING UP A
COMMUNICATION LINK IN A
TELECOMMUNICATION NETWORK

Examiner: Not yet Assigned

Group Art Unit: Not yet Assigned

PRELIMINARY AMENDMENT

Commissioner for Patents
Washington, D.C. 20231

Sir:

Prior to examination on the merits, please amend this application as follows:

In the Specification:

On page 1 before the first paragraph, please delete the following:

~~Description~~

~~GR 98 P 2876 Foreign text~~

On page 1 before the first paragraph, please insert the following new paragraph:

--This application claims priority to International Application No. PCT/DE99/03179
which was published in the German language on October 1, 1999.--

On page 1, between lines 5 and 6 please insert the heading: --TECHNICAL FIELD OF THE INVENTION--.

Please replace the paragraph beginning on line 6 of page 1 with the following rewritten paragraph:

--The invention relates to a method for setting up a connection for a communication network, and in particular, to a method for setting up a connection for a communication network including a multiplicity of network nodes networked via links.--

On page 1, between lines 9 and 10 please insert the heading:

--BACKGROUND OF THE INVENTION--

Please replace the paragraph beginning on line 10 of page 1 with the following rewritten paragraph:

--At present, there are a variety of connectionless and connection-oriented transmission methods which are used for rapidly transmitting data packets via a communication network.--

Please replace the paragraph beginning on line 14 of page 1 with the following rewritten paragraph:

--The so-called MPLS (multiprotocol label switching) method is used as a connectionless transmission method where an acceleration of the transmission of so-called IP data packets based on the Internet protocol (IP) is to be achieved. In this method, so-called label switching routers (LSR) are provided which can transmit IP data packets at high speed along a route consisting of label switching routers. A conventional router based on the Internet protocol must compare a destination IP address of a received IP data packet with entries in its routing table in order to determine, via a so-called longest match, the link via which the IP data packet is to be forwarded.

A label switching router, in contrast, receives the IP data packet together with a prefixed label and uses this label as table index in order to take from a table the information for identifying the link for forwarding the IP data packet and a new label which is forwarded together with the IP data packet instead of the received label. In this manner, IP data packets can be forwarded much more rapidly.--

On page 2, line 3 please insert the following paragraphs:

--Figure 1 illustrates a setup message for an ATM connection in the form of a so-called μ setup message ATMZ according to the prior art. The μ setup message ATMZ has a 48-byte-large payload area which is shown in 6 rows in each case comprising 8 bytes. Data field T contains an information element defining the type of the ATM cell, data field Q contains a connection parameter by means of which individual characteristics of the connection to be set up are specified, data fields NSAP contain the address of the destination network node, data field PID contains a so-called protocol identifier and data field VPI/VCI contains a proposed value for the so-called virtual path identifier VPI and the so-called virtual connection identifier VCI for the ATM cells to be transmitted in the useful data connection to be set up.

SUMMARY OF THE INVENTION

In one embodiment of the invention, there is a method for setting up a connection for a communication network having a multiplicity of network nodes networked via links. The method includes, for example, determining routes to destination network nodes of connection destinations for the network nodes, allocating, in the network nodes, an allocation rule by means of the routes determined, by means of which rule a forwarding information item is allocated both to a link leading in the direction of this destination node and to a new forwarding information item for each destination network node and transmitting a setup message from an originating network node to the destination network nodes for preparing a subsequent transmission of data, such that in a network node receiving the setup message. The method of forwarding a

information item included in the setup message is read out and using the allocation rule, the setup message is forwarded via a link allocated to this forwarding information item in this network node, after replacement of this forwarding information item by a new forwarding information item allocated to the former information item.

In one aspect of the invention, before the setup message is transmitted, the allocation rule by means of which a route-specific forwarding information item is allocated to a link leading in the direction of the respective destination network node for each destination network node is setup in the network nodes.

In another aspect of the invention, the network node receiving a setup message the route-specific forwarding information item included in the setup message is replaced by a new route-specific forwarding information item allocated to this route-specific forwarding information item in the network node, by means of which new information item the setup message is then forwarded.

In still another aspect of the invention, the network nodes a new route-specific forwarding information item allocated to a route-specific forwarding information item is determined by access to a translation table in which a new route-specific forwarding information item is included for each permissible route-specific forwarding information item.

In yet another aspect of the invention, during the access to the translation table, the permissible route-specific forwarding information item is used as a table index.

In another aspect of the invention, in one of the network nodes, one of a number of translation tables set up in the network node is selected depending on a connection parameter included in the setup message, and a new route-specific forwarding information item is determined by means of the selected translation table.

In yet another aspect of the invention, in each case the new forwarding information item allocated to a forwarding information item in one of the network nodes is allocated, in the network node connected via the link also allocated and leading in the direction of the respective

destination node, as route-specific forwarding information to a link leading in the direction of the same destination network node.

In still another aspect of the invention, the allocation rule is determined and set up in each network node based on information on the structure of the communication network.

In one aspect of the invention, a network nodes, a link allocated to a forwarding information item is determined by access to a link table in which an information item identifying an associated link is included for each permissible forwarding information item.

In another aspect of the invention, during the access to the link table, the permissible route-specific forwarding information item is used as a table index.

In still another aspect of the invention, in one of the network nodes, one of a number of link tables set up in this network node is selected based on a connection parameter included in the setup message and an associated link is determined by means of the selected translation table.

In yet another aspect of the invention, the connection setup takes place in an ATM network.

In another aspect of the invention, a single ATM cell is transmitted as a setup message. In one embodiment of the invention, a system for setting up a connection for a communication network comprising a multiplicity of network nodes networked via links, in which subsequent transmission of useful data along the route of the setup message is prepared by transmitting a setup message from an originating network node to a destination network node, characterized in that a route-specific forwarding information item contained in the setup message is read out in a network node receiving the setup message, and the setup message is forwarded via a link allocated to this route-specific forwarding information item in this network node.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 shows a setup message according to the prior art.

Figure 2 shows a communication network with a multiplicity of network nodes connected via links.

Figure 3 shows the same communication network with a routing tree assembled from a number of routing branches.

Figure 4 shows a routing branch of the routing tree.

Figure 5 shows routing branches subordinate to this routing branch.

DETAILED DESCRIPTION OF THE INVENTION--

Please replace the paragraph beginning on line 4 of page 4 with the following rewritten paragraph:

--The present invention includes a method for setting up a connection for a communication network which allows rapid transmission of a setup message.--

On page 4, please delete lines 8-13.

On page 5, please delete lines 16-30.

On page 6, please delete lines 1-16.

Please replace the paragraph beginning on line 17 of page 6 with the following rewritten paragraph:

--According to the invention, a slightly modified setup message ATMZ of Figure 1 is transmitted instead of by hop-by-hop routing by means of a new routing method which will be called pilot routing in the text which follows.--

Please replace the paragraph beginning on line 22 of page 6 with the following rewritten paragraph:

--The negotiable VPI/VCI proposal for the useful data packets in the prior art is replaced, according to the invention, by a forwarding information item, called pilot VPI/VCI, for the μ setup method ATMZ itself in the μ setup message ATMZ. The pilot VPI/VCI is used in each transit network node for determining an ongoing link and an ongoing pilot VPI/VCI which are allocated to the received pilot VPI/VCI in the transit network node, within a very short time. For example, a corresponding switching or translation table, preferably a hardware table, can be indexed by a received pilot VPI/VCI. In this manner the μ setup message ATMZ can be transmitted at the speed of useful data ATM cells to the respective destination node.--

Please replace the paragraph beginning on line 10 of page 7 with the following rewritten paragraph:

--Before these pilot VPI/VCI's can be determined, the routes along which a μ setup message ATMZ is transmitted to a destination node is first be determined. These routes are generally branched in the manner of a tree - comparable to MPTs in the MPLS method but with the distinction that no data streams are to be combined. As a rule, the routes for a setup message ATMZ are much simpler structures than normal ATM useful data connections since only route-specific information and no connection-specific information plays a role (no service categories, cell rates, etc.). For this reason, these routes can also be set up and cleared down with much simpler means than normal ATM useful data connections as discussed in the text which follows:--

Please replace the paragraph beginning on line 26 of page 7 with the following rewritten paragraph:

--Structure of a pilot VPI/VCI route branched in the manner of a tree:

To simplify the discussion, an hierarchically flat so-called PNNI (Private network node interface for ATM networks) network is considered as the communication network. This is shown diagrammatically in Figure. The communication network includes a multiplicity of network nodes NK connected via links LL, only a few network nodes being provided with reference symbols for the sake of clarity. One network node ZK and one network node TK are especially marked. The following method sequences described on the example of the network node ZK are correspondingly also performed by the other network nodes NK.--

Please replace the paragraph beginning on line 15 of page 8 with the following rewritten paragraph:

--The network node ZK initially calculates (e.g. with the aid of the Dijkstra routing algorithm) a routing tree which is assumed to have the form indicated by thickened lines in Figure 3. The routing tree in this case consists of four different routing branches LZ1, LZ2, LZ3 and LZ4.--

Please replace the paragraph beginning on line 21 of page 8 with the following rewritten paragraph:

--After that, the network node ZK sends one setup datagram each (e.g. to be defined in the context of "ATM connectionless") to its neighboring network nodes via the links coming from it. The setup datagram should not be confused with a setup message or μ setup message. The setup datagrams are used for establishing the routes and pilot VPI/VCI concatenations for all possible destination nodes before connections are set up so that setup messages or μ setup messages to be transmitted thereafter can be transmitted very rapidly with the aid of the pilot VPI/VCI concatenations which are then available. A setup datagram has the following content in each case:

- Datagram type = "setup of a tree-like pilot VPI/VCI route",

- pilot destination node = ZK, i.e. the network node ZK itself (this information is not changed when the setup datagram is forwarded),
- pilot VPI/VCI with respect to the respective link via which the setup datagram is just being sent, issued by the emitting node ZK, and
- source routing information. This depends on the network node receiving the respective setup datagram. For the network node TK, this source routing information consists, e.g., of all (PNNI) links of the routing branch LZ3 (given per network node ID and port ID) without the link between network node ZK and network node TK which has just been passed, and of information elements describing the tree structure of the route.--

Please replace the paragraph beginning on line 21 of page 8 with the following rewritten paragraph:

--After that, the network node ZK sends one setup datagram each (e.g. to be defined in the context of "ATM connectionless") to its neighboring network nodes via the links coming from it. The setup datagram should not be confused with a setup message or μ setup message. The setup datagrams are used for establishing the routes and pilot VPI/VCI concatenations for all possible destination nodes before connections are set up so that setup messages or μ setup messages to be transmitted thereafter can be transmitted very rapidly with the aid of the pilot VPI/VCI concatenations which are then available. A setup datagram has the following content in each case:

- Datagram type = "setup of a tree-like pilot VPI/VCI route",
- pilot destination node = ZK, i.e. the network node ZK itself (this information is not changed when the setup datagram is forwarded),
- pilot VPI/VCI with respect to the respective link via which the setup datagram is just being sent, issued by the emitting node ZK, and
- source routing information. This depends on the network node receiving the respective setup datagram. For the network node TK, this source routing information consists, e.g., of all

(PNNI) links of the routing branch LZ3 (given per network node ID and port ID) without the link between network node ZK and network node TK which has just been passed, and of information elements describing the tree structure of the route.--

Please replace the paragraph beginning on line 20 of page 9 with the following rewritten paragraph:

--Treatment of the setup datagram:

A network node receiving a setup datagram calls up a processing routine which recognizes immediately ongoing links and the source routing information, in each case to be forwarded by these links, of the respective adjoining routing branch, by means of the received source routing information. The network node assigns to each detected ongoing link a "continuation" pilot VPI/VCI and generates entries for the switching table, in such a manner that later, if a μ setup message ATMZ should come to this network node, it can address and evaluate the correct switching table entry in order to forward this μ setup message ATMZ in the direction of the pilot destination node ZK. These table entries can also be concatenated in such a manner that later, when a clear-down datagram for clearing down a pilot VPI/VCI route which has been set up is received from the direction of the pilot destination node ZK, they can be found in a simple manner, evaluated for forwarding the clear-down datagram and finally deleted.--

Please replace the paragraph beginning on line 9 of page 10 with the following rewritten paragraph:

--The routing branch LZ3 is shown in detail in Figure 4. Using the received source routing information, the network node TK recognizes the links L1 and L2 coming from it as ongoing links and recognizes which part of the received source routing information is in each case to be forwarded via the link L1 or via link L2, respectively.--

Please replace the paragraph beginning on line 16 of page 10 with the following rewritten paragraph:

--Figure 5 illustrates the routing branches UZ1 and UZ2 of routing branch LZ3 in each case adjoining links L1 and L2. From the network node TK, a part of the received source routing information describing the routing branch UZ1 is correspondingly transmitted via link L1 and a part of the received source routing information describing the routing branch UZ2 is transmitted via link L2, in each case in a setup datagram.--

On page 12, line 13, please replace "Patent Claims" with --WHAT IS CLAIMED IS--.

In the Claims:

1. (Amended) A method for setting up a connection for a communication network having a multiplicity of network nodes networked via links, comprising:

determining routes to destination network nodes of connection destinations for the network nodes;

allocating, in the network nodes, an allocation rule by means of the routes determined, by means of which rule a forwarding information item is allocated both to a link leading in the direction of the destination node and to a new forwarding information item for each destination network node; and

transmitting a setup message from an originating network node to the destination network nodes for preparing a subsequent transmission of data, such that in a network node receiving the setup message,

a forwarding information item included in the setup message is read out, and

using the allocation rule, the setup message is forwarded via a link allocated to this forwarding information item in this network node, after replacement of this forwarding information item by a new forwarding information item allocated to the former information item.

2. (Amended) The method as claimed in claim 1, wherein before the setup message is transmitted, the allocation rule by means of which a route-specific forwarding information item is allocated to a link leading in the direction of the respective destination network node for each destination network node is setup in the network nodes.

3. (Amended) The method as claimed in claim 1 wherein, in a network node receiving a setup message the route-specific forwarding information item included in the setup message is replaced by a new route-specific forwarding information item allocated to this route-specific forwarding information item in the network node, by means of which new information item the setup message is then forwarded.

4. (Amended) The method as claimed in claim 3, wherein, in one of the network nodes a new route-specific forwarding information item allocated to a route-specific forwarding information item is determined by access to a translation table in which a new route-specific forwarding information item is included for each permissible route-specific forwarding information item.

5. (Amended) The method as claimed in claim 4, wherein during the access to the translation table, the permissible route-specific forwarding information item is used as a table index.

6. (Amended) The method as claimed in claim 4 wherein, in one of the network nodes, one of a number of translation tables set up in the network node is selected depending on a connection parameter included in the setup message, and a new route-specific forwarding information item is determined by means of the selected translation table.

7. (Amended) The method as claimed in claim 3, wherein in each case the new forwarding information item allocated to a forwarding information item in one of the network nodes is allocated, in the network node connected via the link also allocated and leading in the direction of the respective destination node, as route-specific forwarding information to a link leading in the direction of the same destination network node.

8. (Amended) The method as claimed in claim 2, wherein the allocation rule is determined and set up in each network node based on information on the structure of the communication network.

9. (Amended) The method as claimed in claim 2, wherein in one of the a network nodes, a link allocated to a forwarding information item is determined by access to a link table in which an information item identifying an associated link is included for each permissible forwarding information item.

10. (Amended) The method as claimed in claim 9, wherein during the access to the link table, the permissible route-specific forwarding information item is used as a table index.

11. (Amended) The method as claimed in claim 9, wherein in one of the network nodes, one of a number of link tables set up in this network node is selected based on a connection parameter included in the setup message, and
an associated link is determined by means of the selected translation table.

12. (Amended) The method as claimed in claim 9, wherein the connection setup takes place in an ATM network.

13. (Amended) The method as claimed in claim 12, wherein a single ATM cell is transmitted as a setup message.

Please add the following new claim:

--14. A system for setting up a connection for a communication network having a multiplicity of network nodes networked via links, comprising:

routes leading to destination network nodes for the network nodes;

an allocation rule, in the network nodes, by means of the routes determined, by means of which rule a forwarding information item is allocated both to a link leading in the direction of the destination node and to a new forwarding information item for each destination network node; and

a setup message transmitted from an originating network node to the destination network nodes for preparing a subsequent transmission of data, such that in a network node receiving the setup message,

a forwarding information item included in the setup message is read out, and

using the allocation rule, the setup message is forwarded via a link allocated to this forwarding information item in this network node, after replacement of this forwarding information item by a new forwarding information item allocated to the former information item.--

In the Abstract:

Please replace the abstract with the new abstract attached hereto.

REMARKS

The above amendments to the specification, claims and abstract have been made to place the application in proper U.S. format and to conform with proper grammatical and idiomatic English. None of the amendments herein are made for reasons related to patentability. No new matter has been added.

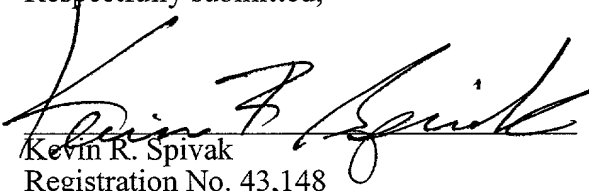
Attached hereto is a marked-up version of the changes made to the specification and claims by the current amendment. The attached page is captioned "Version with markings to show changes made".

In the unlikely event that the transmittal letter is separated from this document and the Patent Office determines that an extension and/or other relief is required, applicant petitions for any required relief including extensions of time and authorizes the Assistant Commissioner to charge the cost of such petitions and/or other fees due in connection with the filing of this document to Deposit Account No. 03-1952 referencing docket no. 449122002600. However, the Assistant Commissioner is not authorized to charge the cost of the issue fee to the Deposit Account.

Respectfully submitted,

Dated: April 4, 2001

By:


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VERSION WITH MARKINGS TO SHOW CHANGES MADE

In the Specification:

Page 1 before the first paragraph, has been amended to delete the following:

~~Description~~

~~GR 98 P 2876 Foreign text~~

Page 1 before the first paragraph, has been amended to include the following insert:

This application claims priority to International Application No. PCT/DE99/03179 which was published in the German language on October 1, 1999.

Page 1, between lines 5 and 6 has been amended to include the following heading:

TECHNICAL FIELD OF THE INVENTION.

Paragraph beginning on line 6 of page 1 has been amended as follows:

The invention relates to a method for setting up a connection for a communication network, and in particular, to a method for setting up a connection for a communication network including comprising a multiplicity of network nodes networked via links, ~~according to the preamble of claim 1.~~

Page 1, between lines 9 and 10 has been amended to include the following heading:

BACKGROUND OF THE INVENTION

Paragraph beginning on line 10 of page 1 has been amended as follows:

At present, there are a variety of various methods, ~~which can be divided into~~ connectionless and connection-oriented transmission methods, which are used for rapidly transmitting data packets via a communication network.

Paragraph beginning on line 14 of page 1 has been amended as follows:

The so-called MPLS (multiprotocol label switching) method is ~~being tried~~ used as a connectionless transmission method ~~by means of which~~ where an acceleration of the transmission of so-called IP data packets based on the Internet protocol (IP) is to be achieved. In this method, so-called label switching routers (LSR) are provided which can transmit IP data packets at high speed along a route consisting of label switching routers. A conventional router based on the Internet protocol must compare a destination IP address of a received IP data packet with entries in its routing table in order to determine, via a so-called longest match, the link via which the IP data packet is to be forwarded. A label switching router, in contrast, receives the IP data packet together with a prefixed label and uses this label as table index in order to take from a table the information for identifying the link for forwarding the IP data packet and a new label which is forwarded together with the IP data packet instead of the received label. In this manner, IP data packets can be forwarded much more rapidly.

On page 2, before line 3, please insert the following paragraphs:

Figure 1 illustrates a setup message for an ATM connection in the form of a so-called μ setup message ATMZ according to the prior art. The μ setup message ATMZ has a 48-byte-large payload area which is shown in 6 rows in each case comprising 8 bytes. Data field T contains an information element defining the type of the ATM cell, data field Q contains a connection parameter by means of which individual characteristics of the connection to be set up are specified, data fields NSAP contain the address of the destination network node, data field PID contains a so-called protocol identifier and data field VPI/VCI contains a proposed value for the so-called virtual path identifier VPI and the so-called virtual connection identifier VCI for the ATM cells to be transmitted in the useful data connection to be set up.

SUMMARY OF THE INVENTION

In one embodiment of the invention, there is a method for setting up a connection for a communication network having a multiplicity of network nodes networked via links. The method includes, for example, determining routes to destination network nodes of connection destinations for the network nodes, allocating, in the network nodes, an allocation rule by means of the routes determined, by means of which rule a forwarding information item is allocated both to a link leading in the direction of this destination node and to a new forwarding information item for each destination network node and transmitting a setup message from an originating network node to the destination network nodes for preparing a subsequent transmission of data, such that in a network node receiving the setup message. The method of forwarding a information item included in the setup message is read out and using the allocation rule, the setup message is forwarded via a link allocated to this forwarding information item in this network node, after replacement of this forwarding information item by a new forwarding information item allocated to the former information item.

In one aspect of the invention, before the setup message is transmitted, the allocation rule by means of which a route-specific forwarding information item is allocated to a link leading in the direction of the respective destination network node for each destination network node is setup in the network nodes.

In another aspect of the invention, the network node receiving a setup message the route-specific forwarding information item included in the setup message is replaced by a new route-specific forwarding information item allocated to this route-specific forwarding information item in the network node, by means of which new information item the setup message is then forwarded.

In still another aspect of the invention, the network nodes a new route-specific forwarding information item allocated to a route-specific forwarding information item is determined by access to a translation table in which a new route-specific forwarding information item is included for each permissible route-specific forwarding information item.

In yet another aspect of the invention, during the access to the translation table, the permissible route-specific forwarding information item is used as a table index.

In another aspect of the invention, in one of the network nodes, one of a number of translation tables set up in the network node is selected depending on a connection parameter included in the setup message, and a new route-specific forwarding information item is determined by means of the selected translation table.

In yet another aspect of the invention, in each case the new forwarding information item allocated to a forwarding information item in one of the network nodes is allocated, in the network node connected via the link also allocated and leading in the direction of the respective destination node, as route-specific forwarding information to a link leading in the direction of the same destination network node.

In still another aspect of the invention, the allocation rule is determined and set up in each network node based on information on the structure of the communication network.

In one aspect of the invention, a network nodes, a link allocated to a forwarding information item is determined by access to a link table in which an information item identifying an associated link is included for each permissible forwarding information item.

In another aspect of the invention, during the access to the link table, the permissible route-specific forwarding information item is used as a table index.

In still another aspect of the invention, in one of the network nodes, one of a number of link tables set up in this network node is selected based on a connection parameter included in the setup message and an associated link is determined by means of the selected translation table.

In yet another aspect of the invention, the connection setup takes place in an ATM network.

In another aspect of the invention, a single ATM cell is transmitted as a setup message.

In one embodiment of the invention, a system for setting up a connection for a communication network comprising a multiplicity of network nodes networked via links, in which subsequent transmission of useful data along the route of the setup message is prepared by

transmitting a setup message from an originating network node to a destination network node, characterized in that a route-specific forwarding information item contained in the setup message is read out in a network node receiving the setup message, and the setup message is forwarded via a link allocated to this route-specific forwarding information item in this network node.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 shows a setup message according to the prior art.

Figure 2 shows a communication network with a multiplicity of network nodes connected via links.

Figure 3 shows the same communication network with a routing tree assembled from a number of routing branches.

Figure 4 shows a routing branch of the routing tree.

Figure 5 shows routing branches subordinate to this routing branch.

DETAILED DESCRIPTION OF THE INVENTION

Paragraph beginning on line 4 of page 4 has been amended as follows:

~~The object of the~~ The present invention consists in specifying includes a method for setting up a connection for a communication network which allows rapid transmission of a setup message.

Paragraph beginning on line 8 of page 4 has been amended as follows:

~~This object is achieved by the characterizing features of claim 1 on the basis of the~~
~~preamble of claim 1.~~

Paragraph beginning on line 11 of page 4 has been amended as follows:

~~Advantageous embodiments and further developments of the invention are specified in the dependent claims.~~

Paragraph beginning on line 16 of page 5 has been amended as follows:

~~In the text which follows, an exemplary embodiment of the invention will be explained in greater detail with reference to the drawing, in which in each case in a diagrammatic representation.~~

Paragraph beginning on line 6 of page 1 has been amended as follows:

~~Figure 1 shows a setup message according to the prior art,~~

~~Figure 2 shows a communication network with a multiplicity of network nodes connected via links,~~

~~Figure 3 shows the same communication network with a routing tree assembled from a number of routing branches,~~

~~Figure 4 shows a routing branch of the routing tree and~~

~~Figure 5 shows routing branches subordinate to this routing branch.~~

Paragraph beginning on line 1 of page 6 has been amended as follows:

~~Figure 1 diagrammatically shows a setup message for an ATM connection in the form of a so-called μ setup message ATMZ according to the prior art. The μ setup message ATMZ has a 48 byte large payload area which is shown in 6 rows in each case comprising 8 bytes. Data field T contains an information element defining the type of the ATM cell, data field Q contains a connection parameter by means of which individual characteristics of the connection to be set up are specified, data fields NSAP contain the address of the destination network node, data field PID contains a so-called protocol identifier and data field VPI/VCI contains a proposed value for~~

~~the so-called virtual path identifier VPI and the so-called virtual connection identifier VCI for the ATM cells to be transmitted in the useful data connection to be set up.~~

Paragraph beginning on line 17 of page 6 has been amended as follows:

~~In the present exemplary embodiment, such~~ According to the invention, a slightly modified setup message ATMZ of Figure 1 is transmitted, ~~according to the invention~~, instead of by hop-by-hop routing by means of a new routing method which will be called pilot routing in the text which follows.

Paragraph beginning on line 22 of page 6 has been amended as follows:

~~For this purpose, the~~ The negotiable VPI/VCI proposal for the useful data packets in the prior art is replaced, according to the invention, by a forwarding information item, called pilot VPI/VCI, for the μ setup method ATMZ itself in the μ setup message ATMZ. The pilot VPI/VCI is used in each transit network node for determining an ongoing link and an ongoing pilot VPI/VCI which are allocated to the received pilot VPI/VCI in the transit network node, within a very short time. For example, a corresponding switching or translation table, preferably a hardware table, can be indexed by a received pilot VPI/VCI. In this manner the μ setup message ATMZ can be transmitted at the speed of useful data ATM cells to the respective destination node.

Paragraph beginning on line 10 of page 7 has been amended as follows:

Before these pilot VPI/VCI's can be determined, the routes along which a μ setup message ATMZ is transmitted to a destination node is ~~must~~ first ~~still~~ be determined. These routes are generally branched in the manner of a tree - comparable to MPTs in the MPLS method but with the distinction that no data streams are to be combined. As a rule, the routes for a setup message ATMZ are much simpler structures than normal ATM useful data connections since only route-specific information and no connection-specific information plays a role (no service

categories, cell rates, etc.). For this reason, these routes can also be set up and cleared down with much simpler means than normal ATM useful data connections as discussed in the text which follows:

Paragraph beginning on line 26 of page 7 has been amended as follows:

Structure of a pilot VPI/VCI route branched in the manner of a tree:

To simplify the discussion, an hierarchically flat so-called PNNI (Private network node interface for ATM networks) network is considered as the communication network. This is shown diagrammatically in Figure figure 2. ~~It consists of~~ The communication network includes a multiplicity of network nodes NK connected via links LL, only a few network nodes being provided with reference symbols for the sake of clarity. One network node ZK and one network node TK are especially marked. The following method sequences described on the example of the network node ZK are correspondingly also performed by the other network nodes NK.

Paragraph beginning on line 15 of page 8 has been amended as follows:

The network node ZK initially calculates (e.g. with the aid of the Dijkstra routing algorithm) a routing tree which is assumed to have the form indicated by thickened lines in figure Figure 3. The routing tree in this case consists of four different routing branches LZ1, LZ2, LZ3 and LZ4.

Paragraph beginning on line 21 of page 8 has been amended as follows:

After that, the network node ZK sends one setup datagram each (e.g. to be defined in the context of "ATM connectionless") to its neighboring network nodes via the links coming from it. The setup datagram ~~must~~ should not be confused with a setup message or μ setup message. The setup datagrams are used for establishing the routes and pilot VPI/VCI concatenations for all possible destination nodes before connections are set up so that setup messages or μ setup messages to be transmitted thereafter can be transmitted very rapidly with the aid of the pilot

VPI/VCI concatenations which are then available. A setup datagram has the following content in each case:

- Datagram type = “setup of a tree-like pilot VPI/VCI route”,
- pilot destination node = ZK, i.e. the network node ZK itself (this information is not changed when the setup datagram is forwarded),
- pilot VPI/VCI with respect to the respective link via which the setup datagram is just being sent, issued by the emitting node ZK, and
- source routing information. This depends on the network node receiving the respective setup datagram. For the network node TK, this source routing information consists, e.g., of all (PNNI) links of the routing branch LZ3 (given per network node ID and port ID) without the link between network node ZK and network node TK which has just been passed, and of information elements describing the tree structure of the route.

Paragraph beginning on line 20 of page 9 has been amended as follows:

Treatment of the setup datagram:

A network node receiving a setup datagram calls up a processing routine which recognizes all immediately ongoing links and the source routing information, in each case to be forwarded by these links, of the respective adjoining routing branch, by means of the received source routing information. The network node assigns to each detected ongoing link a “continuation” pilot VPI/VCI and generates entries for the switching table, in such a manner that later, if a μ setup message ATMZ should come to this network node, it can address and evaluate the correct switching table entry in order to forward this μ setup message ATMZ in the direction of the pilot destination node ZK. These table entries can also be concatenated in such a manner that later, when a clear-down datagram for clearing down a pilot VPI/VCI route which has been set up is received from the direction of the pilot destination node ZK, they can be found in a simple manner, evaluated for forwarding the clear-down datagram and finally deleted.

Paragraph beginning on line 9 of page 10 has been amended as follows:

The routing branch LZ3 is shown in detail in ~~figure~~ Figure 4. Using the received source routing information, the network node TK recognizes the links L1 and L2 coming from it as ongoing links and recognizes which part of the received source routing information is in each case to be forwarded via the link L1 or via link L2, respectively.

Paragraph beginning on line 16 of page 10 has been amended as follows:

Figure 5 ~~diagrammatically shows~~ illustrates the routing branches UZ1 and UZ2 of routing branch LZ3 in each case adjoining links L1 and L2. From the network node TK, a part of the received source routing information describing the routing branch UZ1 is correspondingly transmitted via link L1 and a part of the received source routing information describing the routing branch UZ2 is transmitted via link L2, in each case in a setup datagram.

On page 12, line 13, please replace "Patent Claims" with --WHAT IS CLAIMED IS--.

In the Claims:

1. (Amended) ~~A method for setting up a connection for a communication network comprising a multiplicity of network nodes (NK, TK, ZK) networked via links (LL), in which subsequent transmission of useful data along the route (LZ1, ... LZ4) of the setup message is prepared by transmitting a setup message from an originating network node to a destination network node (ZK), characterized in that a route-specific forwarding information item contained in the setup message is read out in a network node (NK, TK) receiving the setup message, and the setup message is forwarded via a link (LL) allocated to this route-specific forwarding information item in this network node (NK, TK).~~

1. (Amended) A method for setting up a connection for a communication network having a multiplicity of network nodes networked via links, comprising:

determining routes to destination network nodes of connection destinations for the network nodes;

allocating, in the network nodes, an allocation rule by means of the routes determined, by means of which rule a forwarding information item is allocated both to a link leading in the direction of the destination node and to a new forwarding information item for each destination network node; and

transmitting a setup message from an originating network node to the destination network nodes for preparing a subsequent transmission of data, such that in a network node receiving the setup message,

a forwarding information item included in the setup message is read out, and using the allocation rule, the setup message is forwarded via a link allocated to this forwarding information item in this network node, after replacement of this forwarding information item by a new forwarding information item allocated to the former information item.

2. (Amended) The method as claimed in claim 1, ~~characterized in that~~ wherein before the setup message is transmitted, ~~an~~ the allocation rule by means of which a route-specific forwarding information item is allocated to a link (LL) leading in the direction of the respective destination network node (ZK) for each destination network node (ZK) ~~in question~~ is setup in the network nodes (NK, TK, ZK).

3. (Amended) The method as claimed in claim 1 ~~or 2, characterized in that~~ wherein, in a network node (NK, TK) receiving a setup message, the route-specific forwarding information item ~~contained~~ included in the setup message is replaced by a new route-specific forwarding information item allocated to this route-specific forwarding information item in ~~this~~ the network node (NK, TK), by means of which new information item the setup message is then forwarded.

4. (Amended) The method as claimed in claim 3, ~~characterized in that~~ wherein, in a one of the network nodes (TK, NK, ZK), a new route-specific forwarding information item allocated to a route-specific forwarding information item is determined by access to a translation table in which a new route-specific forwarding information item is ~~contained~~ included for each permissible route-specific forwarding information item.

5. (Amended) The method as claimed in claim 4, ~~characterized in that~~ wherein during the access to the translation table, the permissible route-specific forwarding information item is used as a table index.

6. (Amended) The method as claimed in claim 4 ~~or 5, characterized in that~~ wherein, in a one of the network nodes (NK, TK, ZK), one of a number of translation tables set up in ~~this the~~ the network node ~~(NK, TK, ZK)~~ is selected depending on a connection parameter included ~~contained~~ in the setup message, and a new route-specific forwarding information item is determined by means of the selected translation table.

7. (Amended) The method as claimed in claim 3, wherein one of claims 3 to 6, ~~characterized in that~~, in the network nodes (NK, TK, ZK), before the setup message ~~is transmitted, an allocation rule is in each case set up by means of which a route specific forwarding information item is allocated to a link (LL) leading in the direction of the respective destination network node (ZK) and to a new route specific forwarding information item for each destination network node (ZK) in question, in which in each case the new route specific forwarding information item allocated to a route specific forwarding information item in a one of the network nodes (NK, TK, ZK) is allocated, in the network node connected via the link (LL) also allocated and leading in the direction of the respective destination node (ZK), as route-~~

specific forwarding information to a link (~~LL~~) leading in the direction of the same destination network node (~~ZK~~).

8. (Amended) The method as claimed in claim 2, ~~wherein or 7, characterized in that~~ the allocation rule is determined and set up in each network node (~~NK, TK, ZK~~) ~~in dependence~~ based on information on the structure of the communication network ~~which exists there~~.

9. (Amended) The method as claimed in claim 2, wherein ~~one of the preceding claims,~~ ~~characterized in that~~ in one of the a network nodes (~~NK, TK, ZK~~), a link (~~LL~~) allocated to a ~~route-specific~~ forwarding information item is determined by access to a link table in which an information item identifying an associated link (~~LL~~) is ~~contained~~ included for each permissible ~~route-specific~~ forwarding information item.

10. (Amended) The method as claimed in claim 9, ~~characterized in that~~ wherein during the access to the link table, the permissible route-specific forwarding information item is used as a table index.

11. (Amended) The method as claimed in claim 9, ~~wherein or 10, characterized in that,~~ in one of the a network nodes (~~NK, TK, ZK~~), one of a number of link tables set up in this network node (~~NK, TK, ZK~~) is selected ~~in dependence~~ based on a connection parameter ~~contained~~ included in the setup message, and

an associated link (~~LL~~) is determined by means of the selected translation table.

12. (Amended) The method as claimed in claim 9, wherein ~~one of the preceding claims,~~ ~~characterized in that~~ the connection setup takes place in an ATM network.

13. (Amended) The method as claimed in claim 12, wherein characterized in that a
single ATM cell is transmitted as a setup message.

Please add the following new claim:

14. A system for setting up a connection for a communication network having a
multiplicity of network nodes networked via links, comprising:
routes leading to destination network nodes for the network nodes;
an allocation rule, in the network nodes, by means of the routes determined, by means of
which rule a forwarding information item is allocated both to a link leading in the direction of
the destination node and to a new forwarding information item for each destination network
node; and
a setup message transmitted from an originating network node to the destination network
nodes for preparing a subsequent transmission of data, such that in a network node receiving the
setup message,
a forwarding information item included in the setup message is read out, and
using the allocation rule, the setup message is forwarded via a link allocated to this
forwarding information item in this network node, after replacement of this forwarding
information item by a new forwarding information item allocated to the former information item.

--METHOD FOR SETTING UP A CONNECTION FOR A COMMUNICATION NETWORK

ABSTRACT

To set up a connection in a communication network comprising a multiplicity of network nodes connected via links, a setup message is transmitted from an originating network node to a destination network node. In this process, a route-specific forwarding information item included in the setup message is read out in a network node receiving a setup message, by means of which information item the setup message is forwarded via a link allocated to this route-specific forwarding information item in this network node.--

manner, IP data packets can be forwarded much more rapidly.

Before useful data can be transmitted, label switching routers must determined possible routes and sequences of labels describing these routes. The routes are determined in such a manner that, if possible, they combine in a manner of a tree in order to save labels in this manner. Such a route is frequently also-called multipoint-to-point tree (MPT) in this connection. Such an MPT has precisely one root, i.e. one destination node at which terminals with IP addresses from the respective destination IP address range are connected. It is frequently advantageous if a number of MPTs lead to the same destination node and, if necessary, use different paths. Such multiple MPTs can be formed in each case for different transmission parameters such as, e.g. so-called QoS (Quality of Service) attributes.

In the MPLS method, however, the problem remains that a respective originating label switching router must determine the respective first label in a conventional complex manner in order to send an IP data packet to be transmitted via the correct originating link. This is complex especially if specific routes have to be taken into consideration for different transmission parameters or attributes.

Compared with the connectionless data transmission via label switching routers described above, connection-oriented transmission methods for data packets have the advantage that different transmission parameters such as, e.g. the transmission bandwidths to be provided or a maximum permissible transmission period for data packets, of a connection to be set up can be determined by a connection

5 setup message for the connection to be set up which is
to be transmitted in advance. In the connection setup
message which is frequently also-called setup message,
data fields containing various connection parameters,
10 as a rule, are provided for this purpose and are
evaluated in the network nodes receiving the setup
message. The transmission parameters established by the
setup message apply to all data packets to be
transmitted in the connection set up and do not
15 therefore need to be specified in each one of these
data packets.

Among the connection-oriented transmission
methods, ATM (Asynchronous Transfer Mode) technology is
becoming increasingly important. ATM technology can be
15 used for transmitting data packet streams in so-called
switched virtual connections as fast as in the MPLS
method. However, the setting up of a switched virtual
connection still takes a relatively long time. Switched
virtual connections are frequently also designated by
20 the abbreviation SVC.

At present, a method for setting up ATM
connections is being discussed in which a so-called μ
setup message having the size of a single ATM cell is
transmitted through the ATM network as setup message.
25 This method allows the setup message to be transmitted
much more rapidly than in the previously used method
for setting up an ATM connection. The setup message is
transmitted in accordance with the so-called hop-by-hop
principle; i.e. each ATM network node receiving the
30 setup message itself determines the link via which the
ATM cell is to be forwarded. As a consequence of the
hop-by-hop transmission, however, a μ setup message is
still being transmitted

much more slowly than a useful data ATM cell in a connection which is set up, in the abovementioned method.

The object of the present invention consists in specifying a method for setting up a connection for a communication network which allows rapid transmission of a setup message.

This object is achieved by the characterizing features of claim 1 on the basis of the preamble of claim 1.

Advantageous embodiments and further developments of the invention are specified in the dependent claims.

The method according to the invention allows setup messages to be transmitted by a communication network with approximately the same speed as useful data packets transmitted in a connection which has been set up. The advantages of a connection-oriented transmission method can thus be combined with the advantage of a very rapid connection setup.

This results especially in the following advantages for setting up switched virtual connections (SVC):

SVCs can only be set up on demand even with high speed requirements and do not need to be generated in advance for all connections to be expected. Thus, there is no necessity for administering SVCs which have been set up as a precaution which may otherwise be necessary and is expensive.

It is not necessary to reserve any estimated transmission bandwidths in advance as is necessary, for example, in the so-called MPOA (Multiprotocol over ATM), RSVP (Resource Reservation

Protocol) or MPLS method in a direct or indirect manner.

5 In general, there is no loss of quality if several data packet streams are transmitted from the same originating LAN to the same destination LAN (local area network) in a commonly used SVC between an originating router and a destination router.

10 In general, there is no loss of quality if data packet streams coming from a number of network nodes are combined in the manner of a tree. This makes it possible to replace a setting up of a multipoint-to-point ATM connection preferably by setting up individually requested point-to-point ATM SVCs. The latter are to be preferred especially with regard to a
15 simpler billing procedure.

In the text which follows, an exemplary embodiment of the invention will be explained in greater detail with reference to the drawing, in which in each case in a diagrammatic representation

20 Figure 1 shows a setup message according to the prior art,

Figure 2 shows a communication network with a multiplicity of network nodes connected via links,

25 Figure 3 shows the same communication network with a routing tree assembled from a number of routing branches,

Figure 4 shows a routing branch of the routing tree and

30 Figure 5 shows routing branches subordinate to this routing branch.

Figure 1 diagrammatically shows a setup message for an ATM connection in the form of a so-called μ setup message ATMZ according to the prior art. The μ setup message ATMZ has a 48-byte-large payload area which is shown in 6 rows in each case comprising 8 bytes. Data field T contains an information element defining the type of the ATM cell, data field Q contains a connection parameter by means of which individual characteristics of the connection to be set up are specified, data fields NSAP contain the address of the destination network node, data field PID contains a so-called protocol identifier and data field VPI/VCI contains a proposed value for the so-called virtual path identifier VPI and the so-called virtual connection identifier VCI for the ATM cells to be transmitted in the useful data connection to be set up.

In the present exemplary embodiment, such a slightly modified setup message ATMZ is transmitted, according to the invention, instead of by hop-by-hop routing by means of a new routing method which will be called pilot routing in the text which follows.

For this purpose, the negotiable VPI/VCI proposal for the useful data packets is replaced, according to the invention, by a forwarding information item, called pilot VPI/VCI, for the μ setup method ATMZ itself in the μ setup message ATMZ. The pilot VPI/VCI is used in each transit network node for determining an ongoing link and an ongoing pilot VPI/VCI which are allocated to the received pilot VPI/VCI in the transit network node, within a very short time. For example, a corresponding switching or translation table, preferably a hardware table, can be indexed by a received pilot VPI/VCI. In this manner the μ setup message ATMZ can be

transmitted at the speed of useful data ATM cells to the respective destination node.

Before a μ setup message ATMZ is transmitted, an originating node sending the μ setup message ATMZ must determine the destination node by means of the destination address NSAP and then the correct pilot VPI/VCI for the first transmission segment to the immediately following node by means of the destination node.

Before these pilot VPI/VCIs can be determined, the routes along which a μ setup message ATMZ is transmitted to a destination node must first still be determined. These routes are generally branched in the manner of a tree - comparable to MPTs in the MPLS method but with the distinction that no data streams are to be combined. As a rule, the routes for a setup message ATMZ are much simpler structures than normal ATM useful data connections since only route-specific information and no connection-specific information plays a role (no service categories, cell rates, etc.). For this reason, these routes can also be set up and cleared down with much simpler means than normal ATM useful data connections as discussed in the text which follows:

Structure of a pilot VPI/VCI route branched in the manner of a tree:

To simplify the discussion, an hierarchically flat so-called PNNI (Private network node interface for ATM networks) network is considered as the communication network. This is shown diagrammatically in figure 2. It consists of a multiplicity of network nodes NK connected via links LL, only a few network nodes being provided with reference symbols for the sake of clarity. One network node ZK and one network node TK are especially marked. The following

method sequences described on the example of the network node ZK are correspondingly also performed by the other network nodes NK.

Information on the network structure of the PNNI network is transmitted to the network node ZK by means of the so-called PNNI routing protocol. Using this information, the network node ZK thereupon initiates a setting up of tree-like pilot VPI/VCI concatenations, i.e. sequences of allocations of respective incoming and outgoing pilot VPI/VCIs which are branched in the manner of a tree and which all lead to this node. The tree-like pilot VPI/VCI concatenations correspond to so-called spanning trees and are formed as follows:

15 The network node ZK initially calculates (e.g. with the aid of the Dijkstra routing algorithm) a routing tree which is assumed to have the form indicated by thickened lines in figure 3. The routing tree in this case consists of four different routing branches LZ1, LZ2, LZ3 and LZ4.

After that, the network node ZK sends one setup datagram each (e.g. to be defined in the context of "ATM connectionless") to its neighboring network nodes via the links coming from it. The setup datagram must not be confused with a setup message or μ setup message. The setup datagrams are used for establishing the routes and pilot VPI/VCI concatenations for all possible destination nodes before connections are set up so that setup messages or μ setup messages to be transmitted thereafter can be transmitted very rapidly with the aid of the pilot VPI/VCI concatenations which are then available. A setup datagram has the following content in each case:

- Datagram type = "setup of a tree-like pilot VPI/VCI route",

- pilot destination node = ZK, i.e. the network node ZK itself (this information is not changed when the setup datagram is forwarded),
- pilot VPI/VCI with respect to the respective link via
5 which the setup datagram is just being sent, issued by the emitting node ZK, and
- source routing information. This depends on the network node receiving the respective setup datagram. For the network node TK, this source routing
10 information consists, e.g., of all (PNNI) links of the routing branch LZ3 (given per network node ID and port ID) without the link between network node ZK and network node TK which has just been passed, and of information elements describing the tree structure of
15 the route.

Furthermore, a formation of a number of routes in dependence on predeterminable connection attributes can be initiated by additional information.

20 Treatment of the setup datagram:

A network node receiving a setup datagram calls up a processing routine which recognizes all immediately ongoing links and the source routing information, in each case to be forwarded by these
25 links, of the respective adjoining routing branch, by means of the received source routing information. The network node assigns to each detected ongoing link a "continuation" pilot VPI/VCI and generates entries for the switching table, in such a manner that later, if a
30 μ setup message ATMZ should come to this network node, it can address and evaluate the correct switching table entry in order to forward this μ setup message ATMZ in the direction of the pilot destination node ZK. These table entries can also be concatenated in such a manner
35 that later, when a clear-down datagram for clearing down a

pilot VPI/VCI route which has been set up is received from the direction of the pilot destination node ZK, they can be found in a simple manner, evaluated for forwarding the clear-down datagram and finally deleted.

5 In the present exemplary embodiment, the network node TK receives from the network node ZK a source routing information item which describes the routing branch LZ3.

10 The routing branch LZ3 is shown in detail in figure 4. Using the received source routing information, the network node TK recognizes the links L1 and L2 coming from it as ongoing links and recognizes which part of the received source routing information is in each case to be forwarded via the
15 link L1 or via link L2, respectively.

 Figure 5 diagrammatically shows the routing branches UZ1 and UZ2 of routing branch LZ3 in each case adjoining links L1 and L2. From the network node TK, a part of the received source routing information
20 describing the routing branch UZ1 is correspondingly transmitted via link L1 and a part of the received source routing information describing the routing branch UZ2 is transmitted via link L2, in each case in a setup datagram.

25 The evaluation of the source routing information and of the setup datagram is recursively repeated in all network nodes subsequently receiving the setup datagram. By means of this method, the source routing information and the setup datagram are sent
30 free of loops to all network nodes affected. Differently from the MPLS method, no routing loops need to be feared, therefore.

Clearing down a pilot VPI/VCI route branched in the manner of a tree:

5 The pilot destination node ZK initiates the clearing down of a pilot VPI/VCI route by sending out a clear-down datagram with the following content via the links coming from it:

- datagram type = "clear-down of the pilot VPI/VCI route branched in the manner of a tree"
- 10 - pilot VPI/VCI with respect to the respective link via which the clear-down datagram is currently being sent.

Treatment of the clear-down datagram:

15 A network node which receives such a clear-down datagram identifies, by means of the link via which the clear-down datagram has been received and by means of the received pilot VPI/VCI, all relevant entries of its switching table. Using these entries, the network node determines the respective continuation links and the respective continuation pilot VPI/VCIs. The network node then forms the respective continuation clear-down datagrams, deletes the switching table entries and
20 finally releases the continuation pilot VPI/VCIs.
25

Form of the routing trees or spanning trees:

30 The routing tree shown in the drawing has been determined by using as a basis information on the entire network structure, with the optimization criterion of specifying the shortest path to the pilot destination node ZK in each case from each network node. μ setup messages ATMZ to be sent out thereafter
35 can thus come from any network node as originating network node and will always be transmitted to the pilot destination node ZK on the shortest path.

However, there are frequently also motives for different routing such as, for example:

- a) a link which is temporarily fully occupied,
- b) a network node marked as so-called non-transit node and
- c) a so-called call profile which requires that all links to be passed through have certain QoS and/or service category attributes.

Motive a) could have the effect that certain
10 pilot VPI/VCI routes in existence would have to be
cleared down from time to time and replaced by other
ones newly to be setup.

Motive c) could have the effect that a certain pilot destination node calculates the routing trees leading to it several times and in doing so in each case uses as a basis a network structure in which the (remaining, not "blanked out") links satisfy different QoS and/or service category attributes. In this case, an information element which specifies the correct QoS and/or service category attributes must be provided in the setup datagram. In this case, any originating network node can send μ setup messages with different initial pilot VPI/VCIs in each case allocated to one call profile to the same destination network node.

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- 4 -

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Patent claims

JOJOE Pac's PCT/PTO 04 APR 2001

1. A method for setting up a connection for a communication network comprising a multiplicity of network nodes (NK, TK, ZK) networked via links (LL), in which

a) routes (LZ1, ..., LZ4) in each case leading to all destination network nodes (ZK) in question as connection destination are determined for the network nodes (NK, TK, ZK),

b) in the network nodes (NK, TK, ZK), an allocation rule is in each case set up by means of the routes determined (LZ1, ..., LZ4), by means of which rule a forwarding information item is allocated both to a link (LL) leading in the direction of this destination node (ZK) and to a new forwarding information item for each destination network node (ZK) in question, and then

c) a setup message is transmitted from an originating network node (NK, TK) to a destination network node (ZK) for preparing a subsequent transmission of useful data, in such a manner that in a network node (NK, TK) receiving the setup message,

- a forwarding information item contained in the setup message is read out, and

- using the allocation rule, the setup message is forwarded via a link (LL) allocated to this forwarding information item in this network node (NK, TK), after replacement of this forwarding information item by a new forwarding information item allocated to the former information item.

2. The method as claimed in claim 1, characterized in that, in a network node (TK, NK, ZK), a new route-specific forwarding information item allocated to a route-

specific forwarding information item is determined by access to a translation table in which a new route-specific forwarding information item is contained for each permissible route-specific forwarding information item.

3. The method as claimed in claim 2, characterized in that during the access to the translation table, the permissible route-specific forwarding information item is used as table index.

4. The method as claimed in claim 2 or 3, characterized in that, in a network node (NK, TK, ZK), one of a number of translation tables set up in this network node (NK, TK, ZK) is selected depending on a connection parameter contained in the setup message, and a new route-specific forwarding information item is determined by means of the selected translation table.

5. The method as claimed in one of the preceding claims, characterized in that in each case the new forwarding information item allocated to a forwarding information item in a network node (NK, TK, ZK) is allocated, in the network node connected via the link also allocated and leading in the direction of the respective destination node (ZK), as forwarding information to a link leading in the direction of the same destination network node (ZK).

6. The method as claimed in one of the preceding claims, characterized in that the allocation rule is determined and set up in each network node (NK, TK, ZK) in dependence on information on the structure of the

communication network which exists there.

7. The method as claimed in one of the preceding claims,

characterized in that

in a network node (NK, TK, ZK), a link (LL) allocated to a forwarding information item is determined by access to a link table in which an information item identifying an associated link (LL) is contained for each permissible forwarding information item.

8. The method as claimed in claim 7,

characterized in that

during the access to the link table, the permissible forwarding information item is used as table index.

9. The method as claimed in claim 7 or 8,

characterized in that,

in a network node (NK, TK, ZK), one of a number of link tables set up in this network node (NK, TK, ZK) is selected in dependence on a connection parameter contained in the setup message, and an associated link (LL) is determined by means of the selected translation table.

10. The method as claimed in one of the preceding claims,

characterized in that

the connection setup takes place in an ATM network.

11. The method as claimed in claim 10,

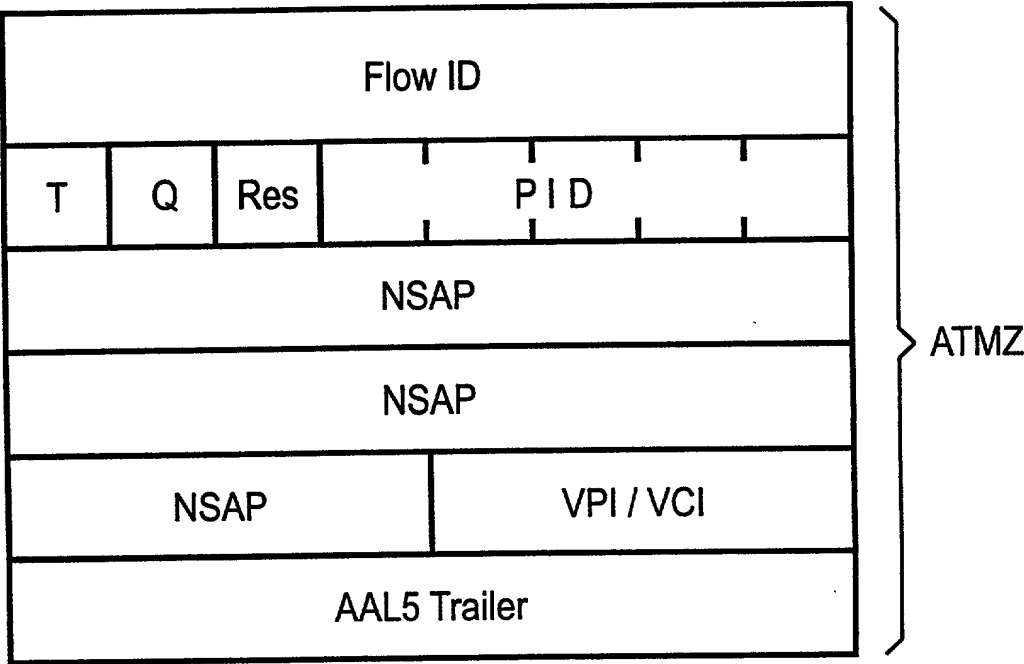
characterized in that

a single ATM cell is transmitted as setup message.

$\frac{d}{dt} \left(\frac{\partial L}{\partial \dot{x}} \right) = \frac{\partial L}{\partial x}$

To set up a connection in a communication network comprising a multiplicity of network nodes (NK, TK, ZK) connected via links (LL), a setup message is transmitted from an originating network node to a destination network node (ZK). In this process, a route-specific forwarding information item contained in the setup message is read out in a network node (NK, TK) receiving a setup message, by means of which information item the setup message is forwarded via a link (LL) allocated to this route-specific forwarding information item in this network node (NK, TK).

FIG 1



PRIOR ART

2/3

FIG 2

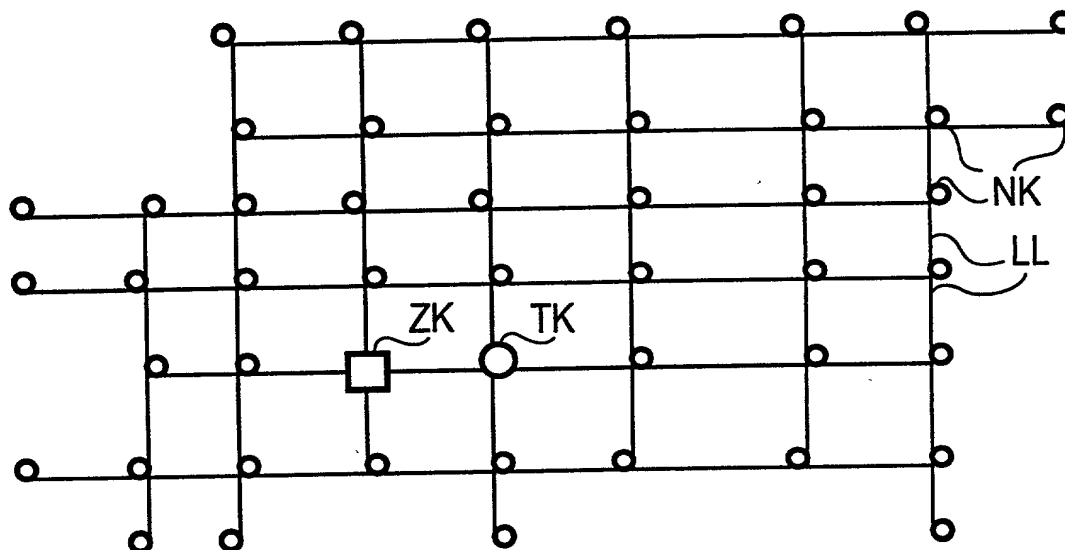


FIG 3

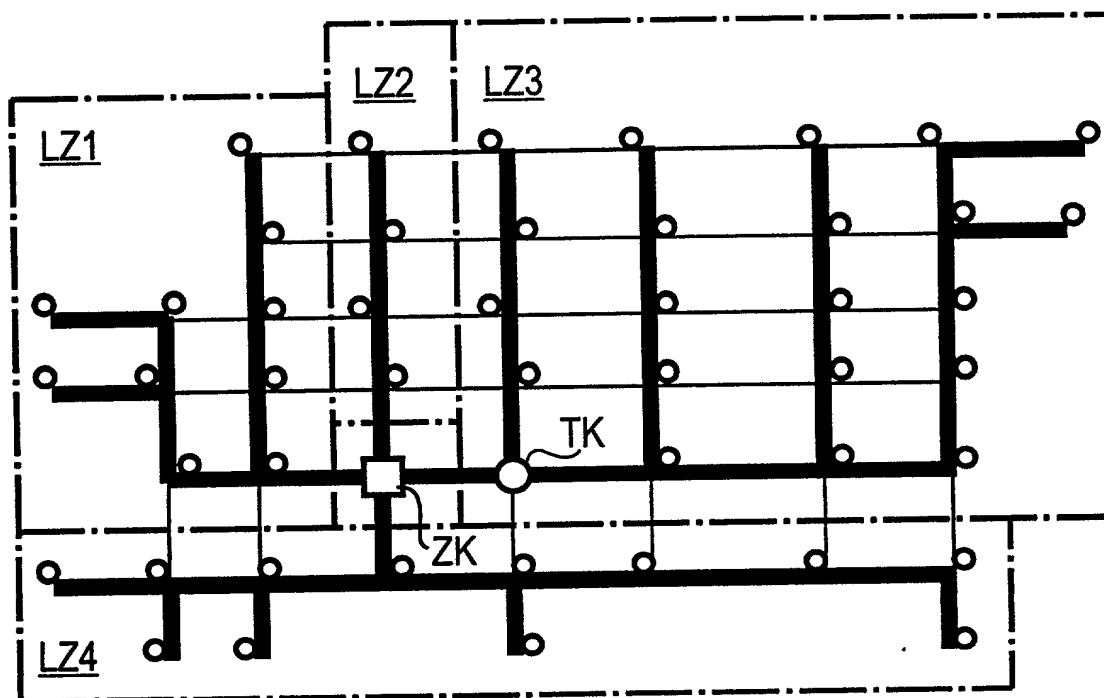


FIG 4

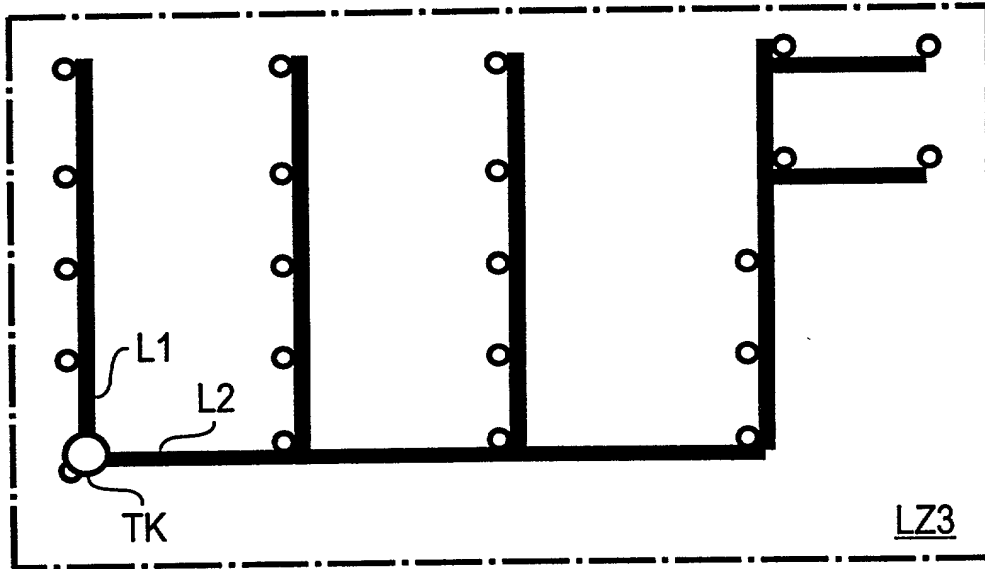
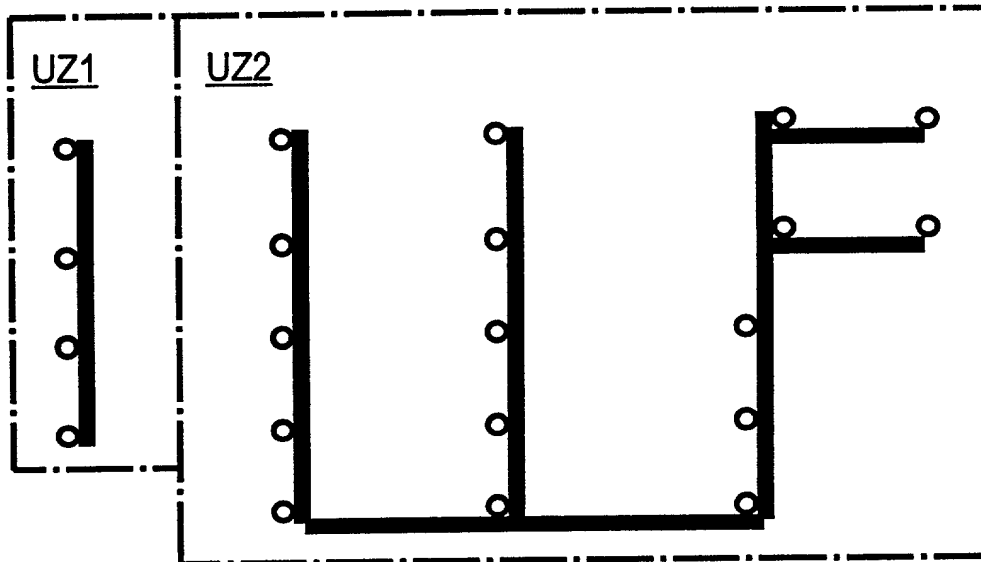


FIG 5



Declaration and Power of Attorney For Patent Application

Erklärung Für Patentanmeldungen Mit Vollmacht

German Language Declaration

Als nachstehend benannter Erfinder erkläre ich hiermit an Eides Statt:

As a below named inventor, I hereby declare that:

dass mein Wohnsitz, meine Postanschrift, und meine Staatsangehörigkeit den im Nachstehenden nach meinem Namen aufgeführten Angaben entsprechen,

My residence, post office address and citizenship are as stated below next to my name,

dass ich, nach bestem Wissen der ursprüngliche, erste und alleinige Erfinder (falls nachstehend nur ein Name angegeben ist) oder ein ursprünglicher, erster und Miterfinder (falls nachstehend mehrere Namen aufgeführt sind) des Gegenstandes bin, für den dieser Antrag gestellt wird und für den ein Patent beantragt wird für die Erfindung mit dem Titel:

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

Verfahren zum Verbindungsaufbau fuer ein Kommunikationsnetz

Method for setting up a communication link in a telecommunication network

deren Beschreibung

the specification of which

(zutreffendes ankreuzen)

(check one)

☐ hier beigefügt ist.

☐ is attached hereto.

☒ am 01.10.1999 als

☒ was filed on 01.10.1999 as

PCT internationale Anmeldung

PCT international application

PCT Anmeldungsnummer PCT/DE99/03179

PCT Application No. PCT/DE99/03179

eingereicht wurde und am

and was amended on

abgeändert wurde (falls tatsächlich abgeändert).

(if applicable)

Ich bestätige hiermit, dass ich den Inhalt der obigen Patentanmeldung einschliesslich der Ansprüche durchgesehen und verstanden habe, die eventuell durch einen Zusatzantrag wie oben erwähnt abgeändert wurde.

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims as amended by any amendment referred to above.

Ich erkenne meine Pflicht zur Offenbarung irgendwelcher Informationen, die für die Prüfung der vorliegenden Anmeldung in Einklang mit Absatz 37, Bundesgesetzbuch, Paragraph 1.56(a) von Wichtigkeit sind, an.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56(a).

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I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

German Language Declaration

Prior foreign applications
Priorität beansprucht

Priority Claimed

19845753.7
(Number)
(Nummer)

DE
(Country)
(Land)

05.10.1998
(Day Month Year Filed)
(Tag Monat Jahr eingereicht)

☒ ☐
Yes No
Ja Nein

(Number)
(Nummer)

(Country)
(Land)

(Day Month Year Filed)
(Tag Monat Jahr eingereicht)

☐ ☐
Yes No
Ja Nein

(Number)
(Nummer)

(Country)
(Land)

(Day Month Year Filed)
(Tag Monat Jahr eingereicht)

☐ ☐
Yes No
Ja Nein

Ich beanspruche hiermit gemäss Absatz 35 der Zivilprozessordnung der Vereinigten Staaten, Paragraph 120, den Vorzug aller unten aufgeführten Anmeldungen und falls der Gegenstand aus jedem Anspruch dieser Anmeldung nicht in einer früheren amerikanischen Patentanmeldung laut dem ersten Paragraphen des Absatzes 35 der Zivilprozessordnung der Vereinigten Staaten, Paragraph 122 offenbart ist, erkenne ich gemäss Absatz 37, Bundesgesetzbuch, Paragraph 1.56(a) meine Pflicht zur Offenbarung von Informationen an, die zwischen dem Anmeldedatum der früheren Anmeldung und dem nationalen oder PCT internationalen Anmeldedatum dieser Anmeldung bekannt geworden sind.

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §122, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application.

PCT/DE99/03179
(Application Serial No.)
(Anmeldeseriennummer)

01.10.1999
(Filing Date D, M, Y)
(Anmeldedatum T, M, J)

(Status)
(patentiert, anhängig,
aufgegeben)

(Status)
(patented, pending,
abandoned)

(Application Serial No.)
(Anmeldeseriennummer)

(Filing Date D,M,Y)
(Anmeldedatum T, M, J)

(Status)
(patentiert, anhängig,
aufgeben)

(Status)
(patented, pending,
abandoned)

Ich erkläre hiermit, dass alle von mir in der vorliegenden Erklärung gemachten Angaben nach meinem besten Wissen und Gewissen der vollen Wahrheit entsprechen, und dass ich diese eidesstattliche Erklärung in Kenntnis dessen abgebe, dass wissentlich und vorsätzlich falsche Angaben gemäss Paragraph 1001, Absatz 18 der Zivilprozessordnung der Vereinigten Staaten von Amerika mit Geldstrafe belegt und/oder Gefängnis bestraft werden koennen, und dass derartig wissentlich und vorsätzlich falsche Angaben die Gültigkeit der vorliegenden Patentanmeldung oder eines darauf erteilten Patentes gefährden können.

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German Language Declaration

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POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith. (list name and registration number)

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Ext. _____

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Unterschrift des Erfinders	Datum	Inventor's signature	Date
X <i>Heinrich Hummel</i> X	31.5.2001	<i>Heinrich Hummel</i>	31st May 2001
Wohnsitz		Residence	
GUENDING, DEUTSCHLAND <i>DEU</i>		GUENDING, GERMANY	
Staatsangehörigkeit		Citizenship	
DE		DE	
Postanschrift		Post Office Address	
ERLENWEG 7		ERLENWEG 7	
85232 GUENDING		85232 GUENDING	
Voller Name des zweiten Miterfinders (falls zutreffend):		Full name of second joint inventor, if any:	
Unterschrift des Erfinders	Datum	Second Inventor's signature	Date
Wohnsitz		Residence	
Staatsangehörigkeit		Citizenship	
Postanschrift		Post Office Address	

(Bitte entsprechende Informationen und Unterschriften im Falle von dritten und weiteren Miterfindern angeben).

(Supply similar information and signature for third and subsequent joint inventors).

2000 P 25227